

COVID-19 and Stroke: New Challenges in Acute Stroke Treatment

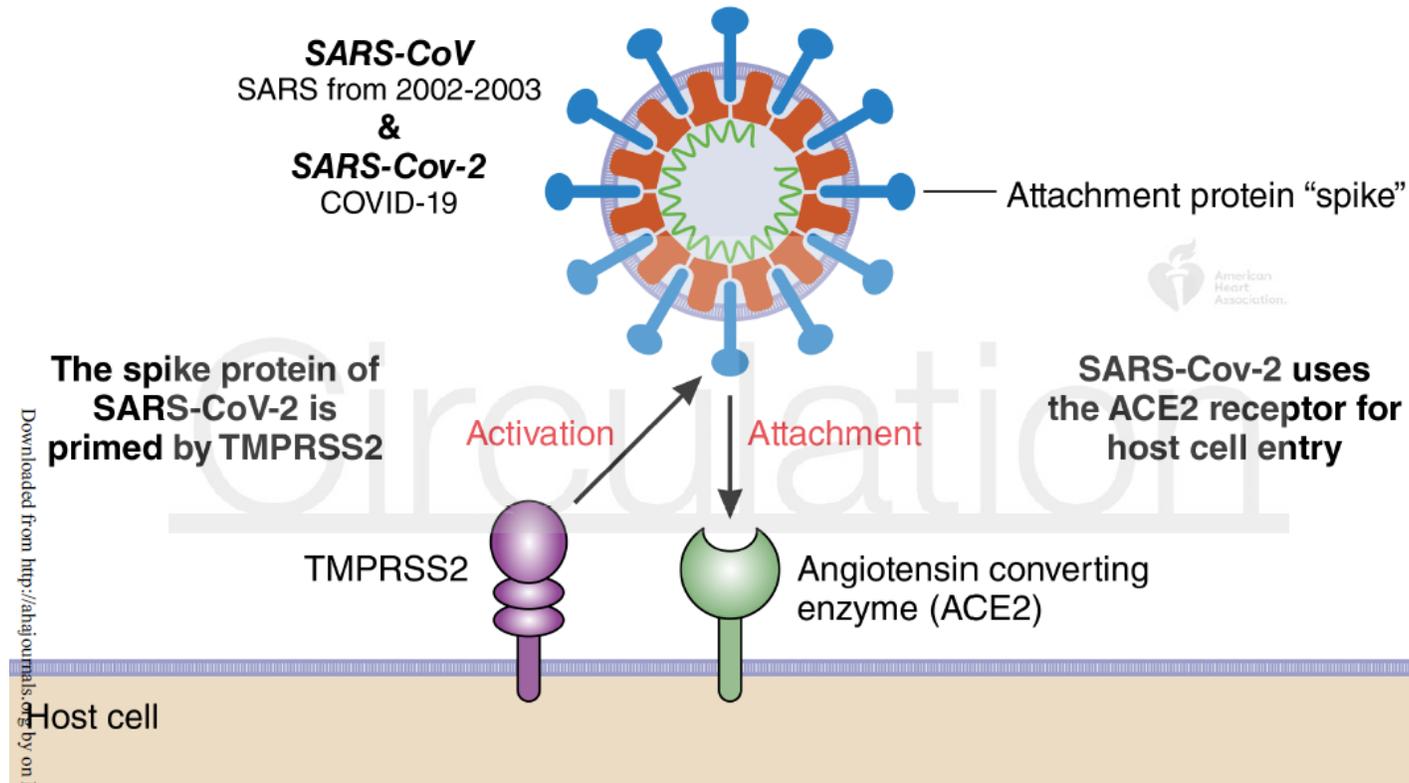
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UVA Health

COVID-19: Mechanism of Action

- ▶ SARS-CoV-2 binds to the angiotensin converting enzyme II receptor
 - ▶ Main target is lower respiratory tract pneumocytes
 - ▶ ACE-2 receptors also found in vascular endothelial cells, pericytes, macrophages, glial cells, cardiac myocytes



COVID-19: Mechanism of Action

- ▶ Viral infection of vascular endothelial cells
 - ▶ Vascular endotheliitis
 - ▶ complement-mediated thrombotic microvascular injury
- ▶ Cytokine storm
 - ▶ Vasoconstriction
 - ▶ Ischemia
 - ▶ Inflammation
 - ▶ Hypercoagulability
- ▶ Anti-phospholipid antibodies
 - ▶ Common in severely ill patients
 - ▶ Reported in COVID-19 infections

COVID-19 and Neurological Risks

▶ Clinical presentation

- ▶ 36%-59% of COVID-19 pts have neurological symptoms
- ▶ Headache, dizziness, myalgias, anosmia, dysguesia
- ▶ Altered mental status, confusion
- ▶ Focal neurological abnormalities
- ▶ Seizures

▶ Neurological complications

- ▶ Infarction—parent vessel occlusion, multiple LVOs, CVT, vasculitis
- ▶ Hemorrhage—intraparenchymal hemorrhage, SAH, microhemorrhages
- ▶ Necrotizing hemorrhagic encephalopathy
- ▶ Leukoencephalopathy
- ▶ Guillain-Barre syndrome

Coronaviruses and Stroke

ORIGINAL COMMUNICATION

Large artery ischaemic stroke in severe acute respiratory syndrome (SARS)

Umapathi J Neurol 2004

5% (11/214) of critically ill COVID-19 pts in China

2.5% of critically ill SARS patients suffered large artery ischemic stroke

Stroke in COVID-19 and SARS-CoV-1

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Collateral Effect of Covid-19 on Stroke Evaluation in the United States

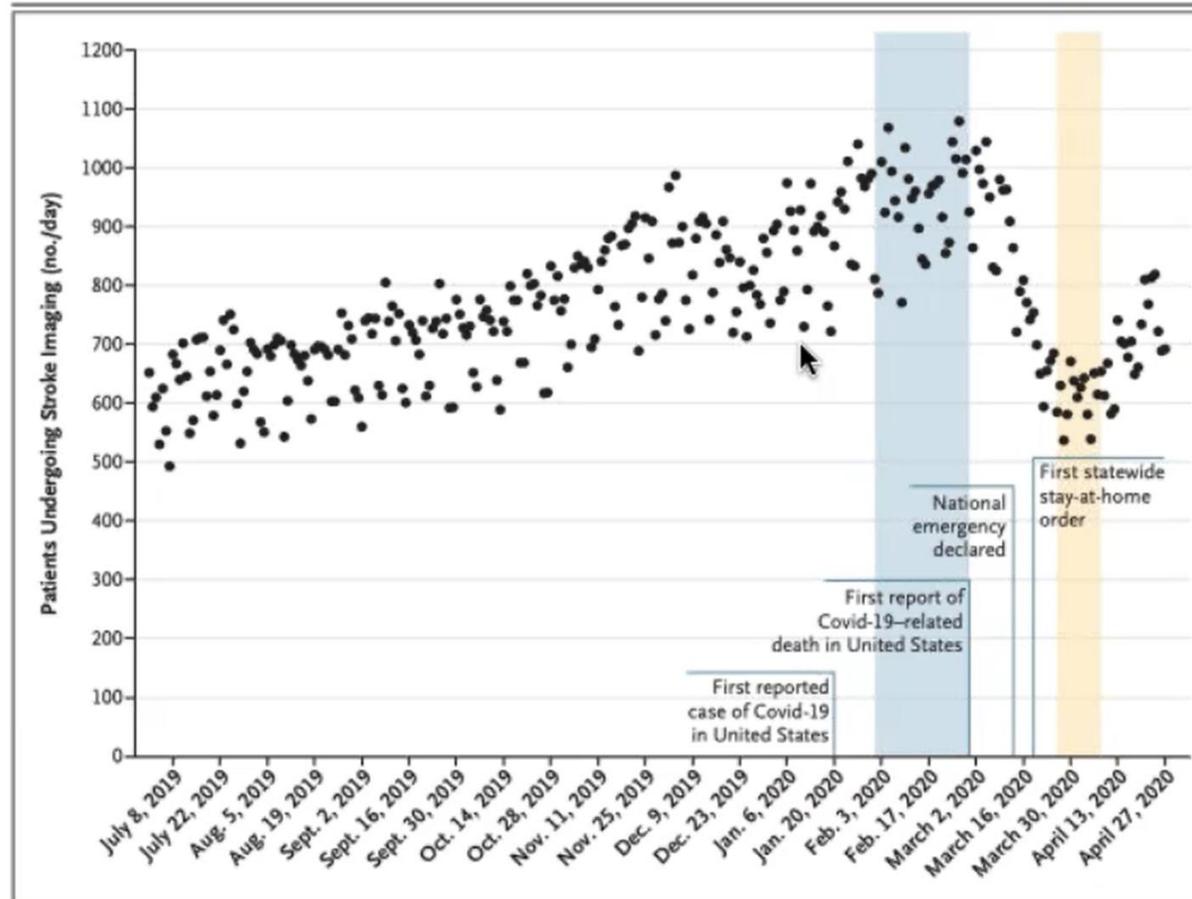


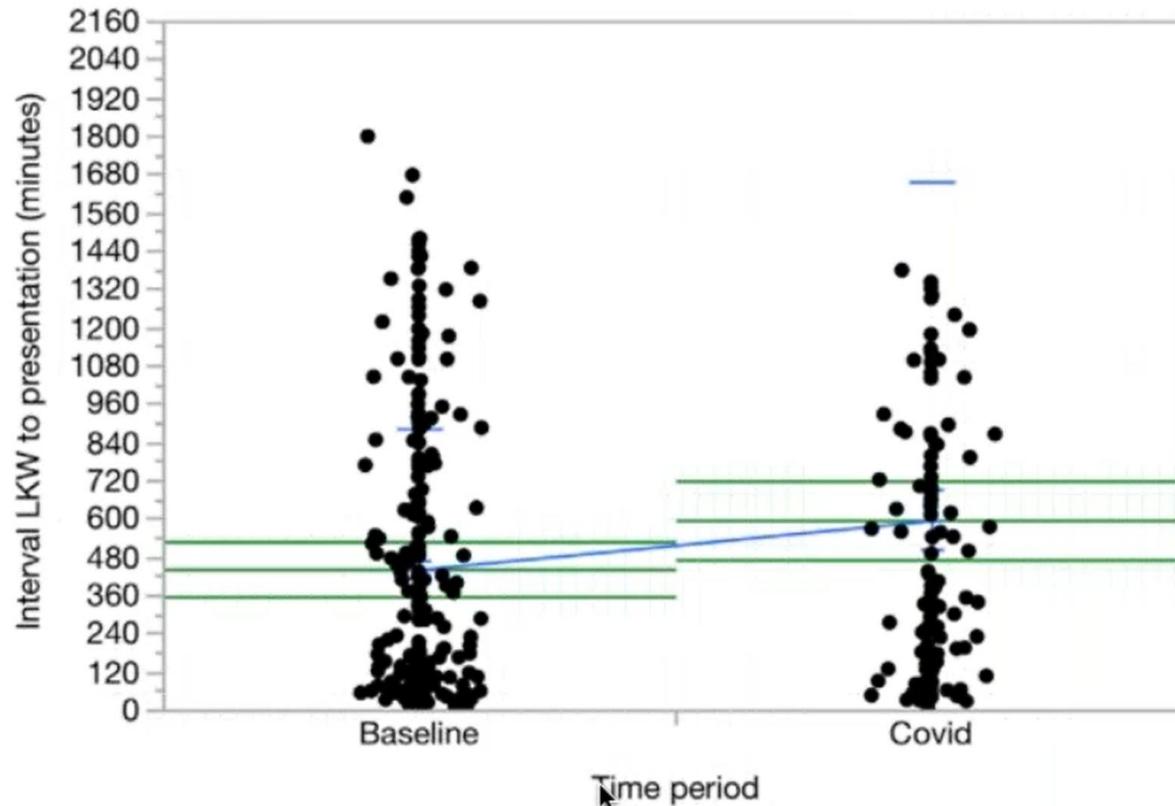
Figure 1. Daily Counts of Unique Patients Who Underwent Neuroimaging for Stroke in the United States, July 2019 through April 2020.

All the neuroimaging tests were processed with RAPID software. Each dot represents a daily count of patients. Shaded regions correspond to the pre-pandemic (blue) and early-pandemic (yellow) epochs. The increase in the number of patients who underwent imaging from July 2019 to March 2020 reflects an increase in the number of hospitals that were using RAPID software.

ORIGINAL RESEARCH

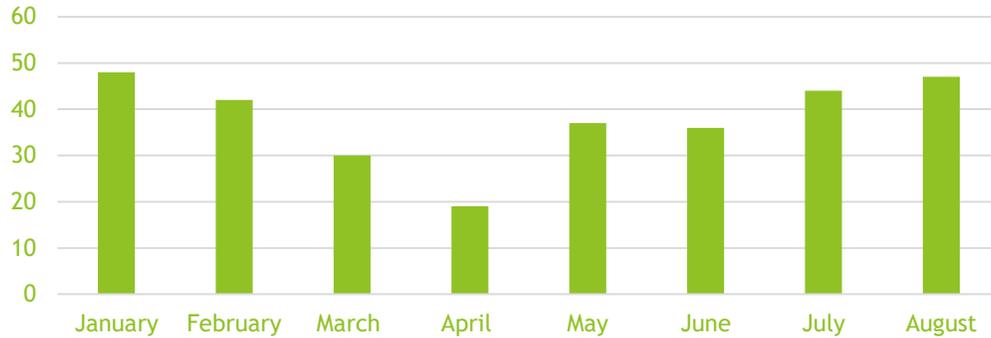
Delayed presentation of acute ischemic strokes during the COVID-19 crisis

Clemens M Schirmer ^{1,2,3} Andrew J Ringer,⁴ Adam S Arthur ^{5,6}
Mandy J Binning,⁷ W Christopher Fox,⁸ Robert F James,⁹ Michael R Levitt ¹⁰
Rabih G Tawk,⁸ Erol Veznedaroglu,⁷ Melanie Walker,¹¹ Alejandro M Spiotta,¹² On
behalf of the Endovascular Research Group (ENRG)

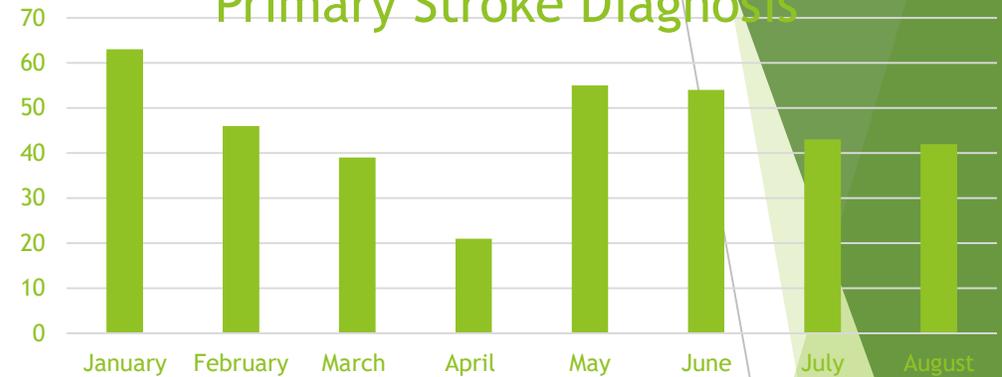


UVA Data

ED Stroke Alerts



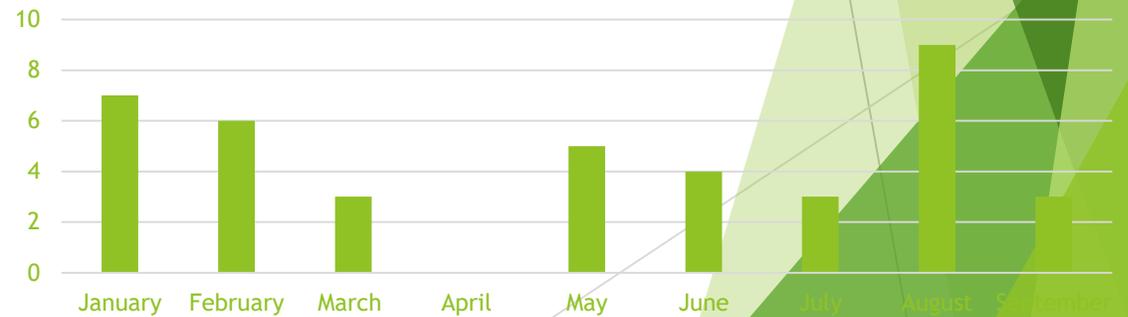
Discharges: Primary Stroke Diagnosis



tPA Volume: Primary Diagnosis Stroke Patients



Thrombectomy Volume: Primary Diagnosis Stroke Patients



March 11, 2020: World Health Organization declared COVID-19 a pandemic.



March 30, 2020: Gov. Ralph Northam issued stay-at-home order.

Impact of COVID-19 on Outcomes in Ischemic Stroke Patients in the U.S.

- **2086 IS-COVID vs 166,586 IS controls from 312 hospitals in 46 states**
- IS-COVID
 - More likely to be male, younger, obese, diabetic
 - Less likely to have HTN, dyslipidemia, or smoke
 - More likely black (34% v 22%) or Hispanic (19% v 7%)
 - More likely to be intubated and have venous thromboembolism
- Outcomes (compared to matched cohort with ischemic stroke and PNA)
 - Lower odds of favorable discharge **0.63** (95% 0.54-0.73)
 - Higher odds of death **1.56** (CI 1.33-1.82)

COVID-19 and AIS with LVO

- ▶ Multi-center study of 3156 AIS pts who received EVT for LVO Apr-Jul 20
 - ▶ COVID-19 positive in 104 pt (3.3%)
- ▶ Characteristics associated with the COVID-19 cohort
 - ▶ Young
 - ▶ More likely to be male, African American or Hispanic, diabetic
 - ▶ More likely to be intubated, ACS, ARF, longer stay in ICU and hospital
- ▶ Rate of in-hospital death
 - ▶ 12.4% without COVID-19 vs 29.8% with COVID-19 ($p < .001$, OR: 4.48)
- ▶ COVID-19 associated with lower odds of favorable discharge (OR:0.43)

> [J Neurointerv Surg. 2020 Nov;12\(11\):1045-1048. doi: 10.1136/neurintsurg-2020-016777.](#)
Epub 2020 Sep 28.

Endovascular thrombectomy in acute ischemic stroke patients with COVID-19: prevalence, demographics, and outcomes

Mechanical Thrombectomy in Covid-19 LVO Strokes

- ▶ Higher NIHSS
- ▶ Larger thrombus burden (+ atypical clot locations)
- ▶ Higher rate of multivessel occlusion (40-50%)
- ▶ Larger ischemic core volume
- ▶ Successful recanalization rates: 77-92%
 - ▶ Higher rate of early re-occlusion
- ▶ Higher rate of non-cerebral thrombotic events
- ▶ Other organ failure

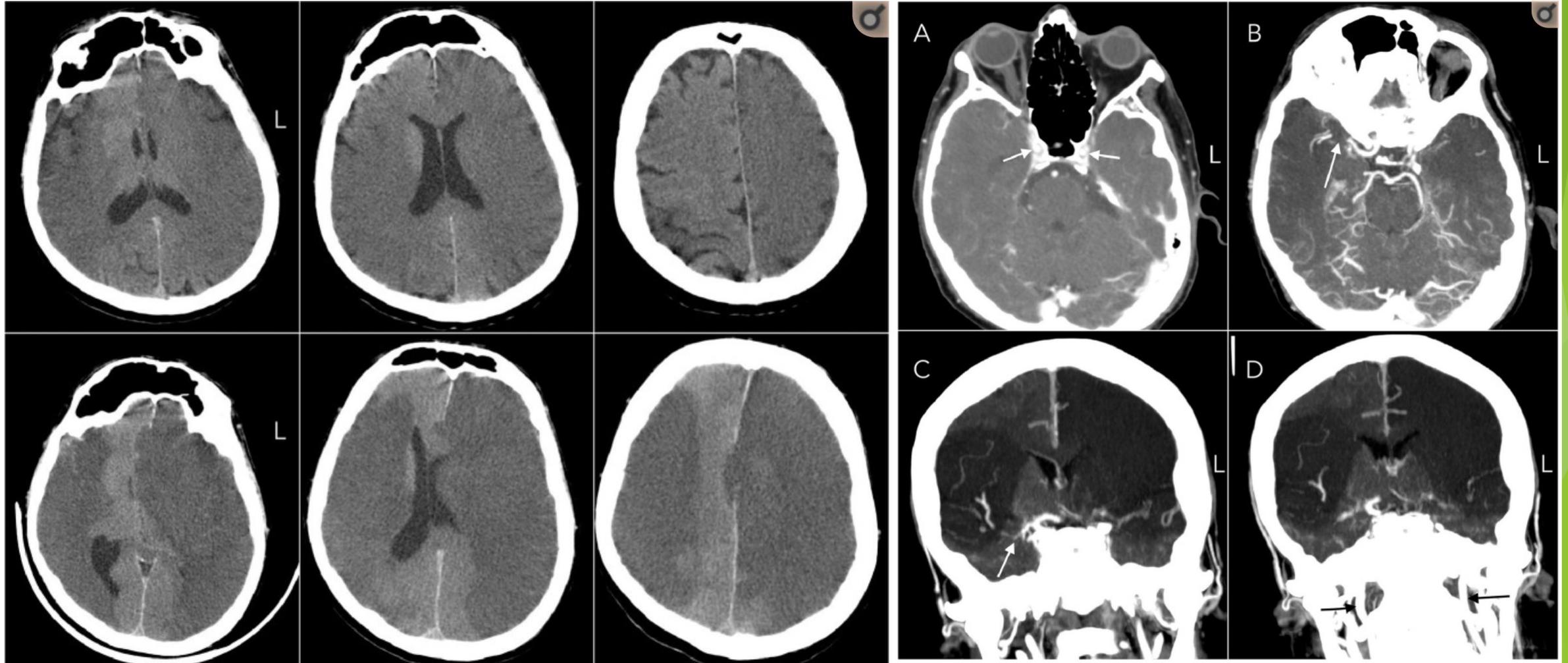
> [Stroke](#). 2020 Nov;51(11):3366-3370. doi: 10.1161/STROKEAHA.120.031011. Epub 2020 Aug 19.

Early Brain Imaging Shows Increased Severity of Acute Ischemic Strokes With Large Vessel Occlusion in COVID-19 Patients

COVID-19 Patient with Occlusion of the Left CCA/ICA/MCA



COVID-19 Patient Presenting with Bilateral LVOs



Relationship or a Lot of Noise?

- ▶ LVOs seen at a higher rate (40-50% of all strokes)
- ▶ Higher risk of cryptogenic strokes
 - ▶ twice as frequent in Covid-19 patients than the non-infected population
- ▶ Cryptogenic strokes associated with Covid-19 have a poor prognosis
 - ▶ 5-fold greater odds of in-hospital mortality
- ▶ Independent of respiratory disease
- ▶ Strong impact and resources

Stroke and COVID-19: A True Relationship or a Lot of Noise? SNIS 19 Annual Mtg 2021
Raphe Blanc, M.D., Rothschild Foundation
Hospital, Paris, FR

Case Study: MT for LVO in COVID+ Patient

79 yo RH woman p/w sudden onset confusion and right sided weakness (LKW 90 min prior)

- PMHx: HTN, **COVID+** 8 days ago with only fatigue, mild fever, quarantining at home; no respiratory sx
- Stroke attending/team leader performs NIHSS via teleneurology

Telestroke Assessment

Vitals: Afebrile, SpO2 97% RA, RR 16, HR 90, **BP 200/105**

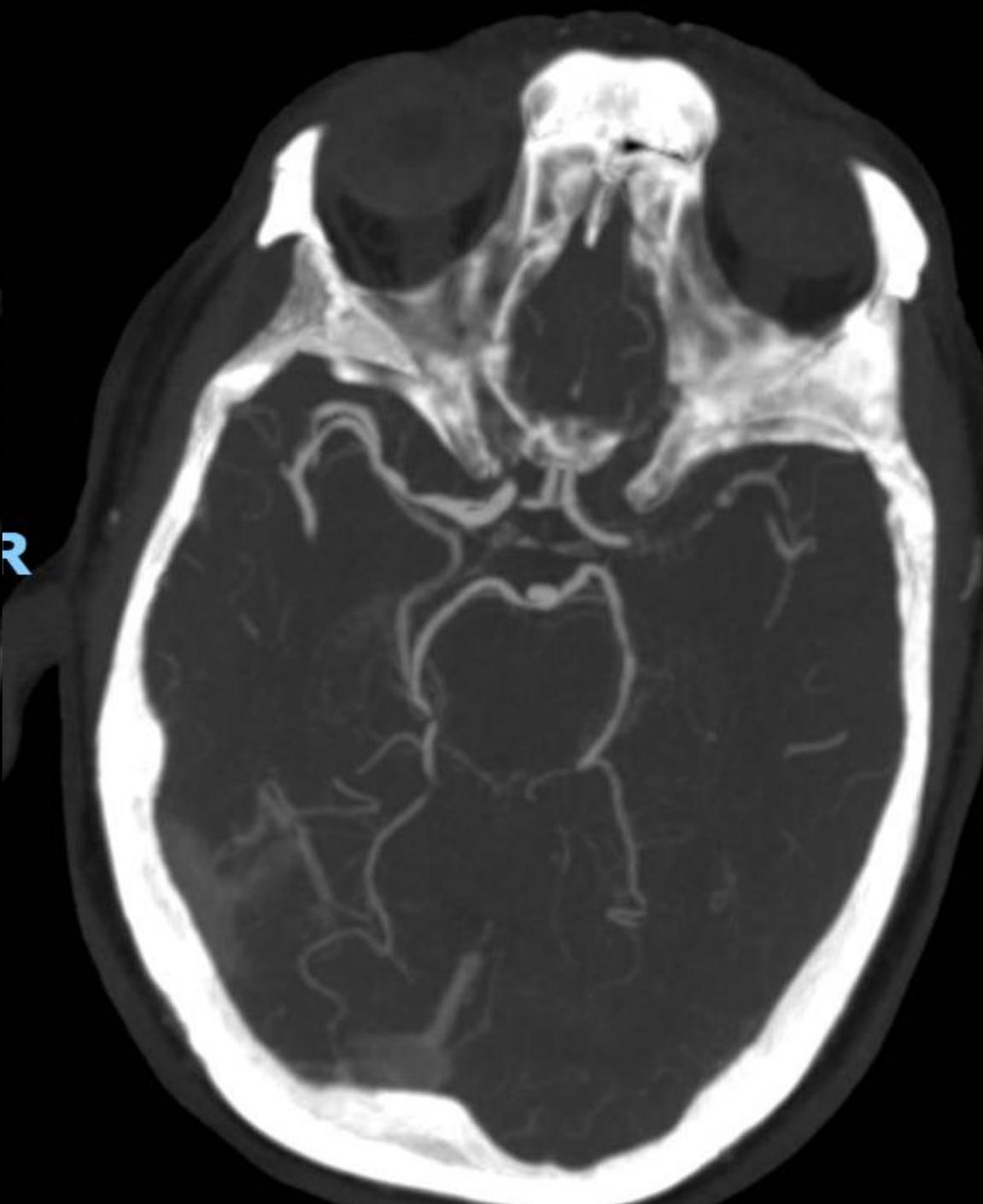
Neuro Exam:

- Global aphasia
- Fixed left gaze preference
- No blink to threat on the right
- Right arm/leg hemiplegia

- NIHSS 24



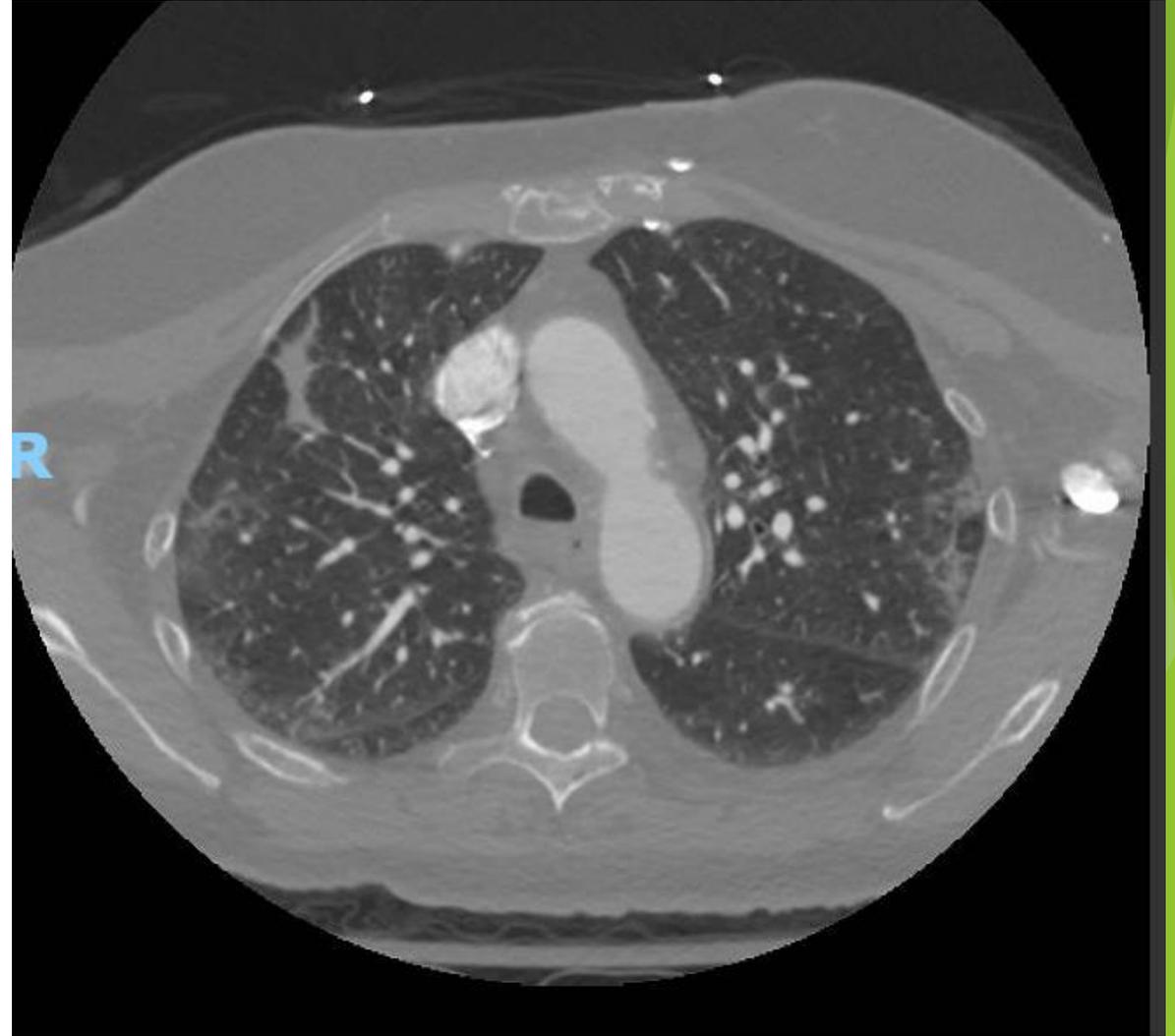
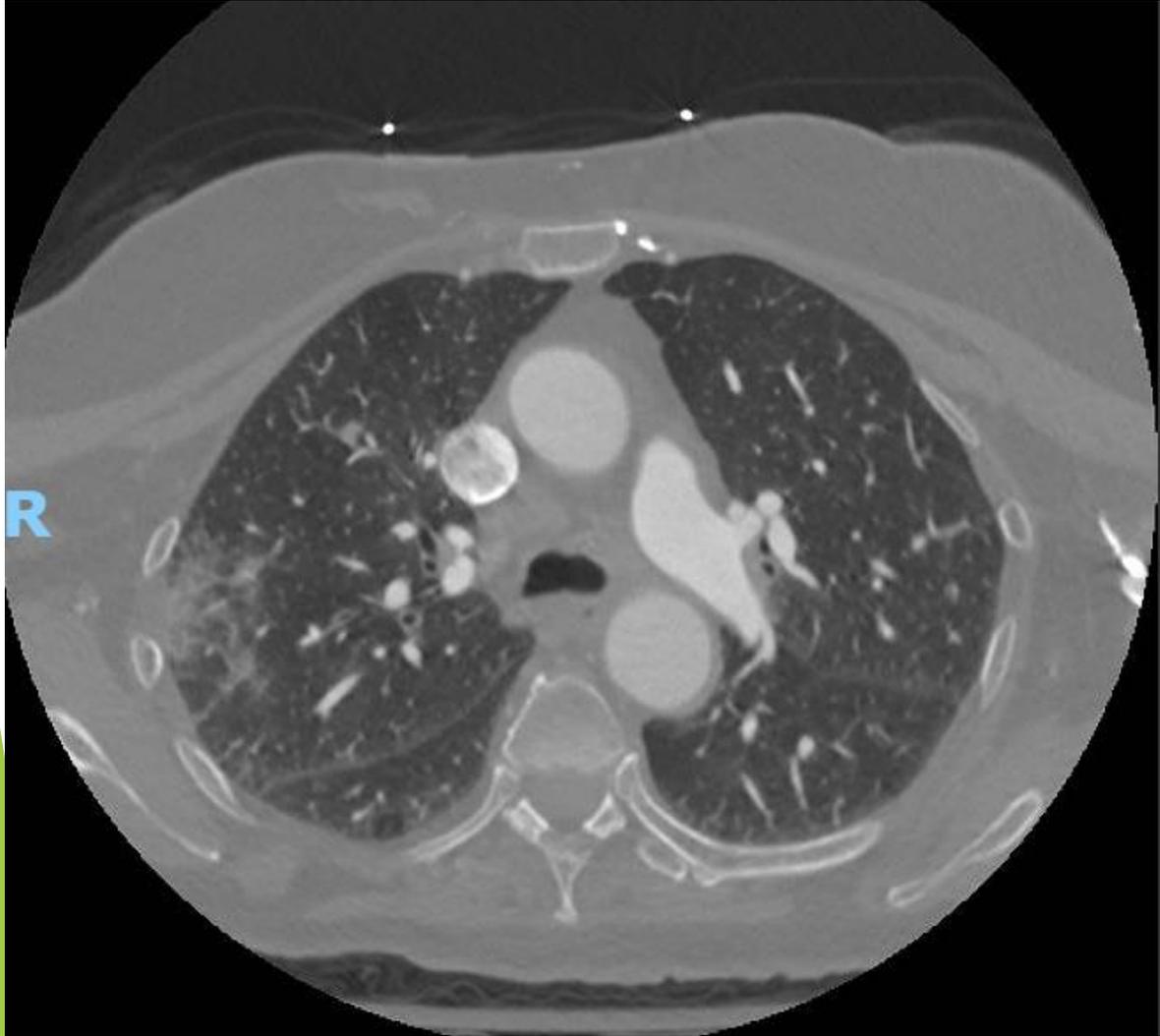




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Peripheral-Based, Bilateral Ground Glass Opacities



April 1, 2020

Special Report

Protected Code Stroke

Hyperacute Stroke Management During the Coronavirus Disease 2019 (COVID-19) Pandemic

Houman Khosravani[©], MD, PhD; Phavalan Rajendram, MD;
Lowyl Notario, MSc; Martin G. Chapman, MD; Bijoy K. Menon, MD, MSc

April 14, 2020

Mechanical Thrombectomy in the Era of the COVID-19 Pandemic: Emergency Preparedness for Neuroscience Teams A Guidance Statement From the Society of Vascular and Interventional Neurology

Protected Code Stroke

+ Positive Screen for COVID-19



Pre-notification screening: communication with paramedics or sending facility prior to arrival - **Positive infection screen:**

patient is exhibiting or has close contacts with infectious symptoms and/or travel history



Unclear or unable to obtain history: patient is obtunded or not able to communicate. History or exam features suggestive of an alternate diagnosis

INSIDE Room



MD1



RN1



Mask
On Patient



RN2/RT
(Optional)

DO NOT use stethoscope (contamination)

OUTSIDE Room



MD2



Safety
Lead

- Safety Lead to monitor PPE
- All charting OUTSIDE ROOM

EXPERIENCED STAFF — MD1 (ATTENDING OR SR. TRAINEE)

Required PPE (use donning/doffing checklist):

1. Full-sleeve gown
2. Surgical Mask
3. +/- Head covering (optional)
4. Face Shield
5. Gloves



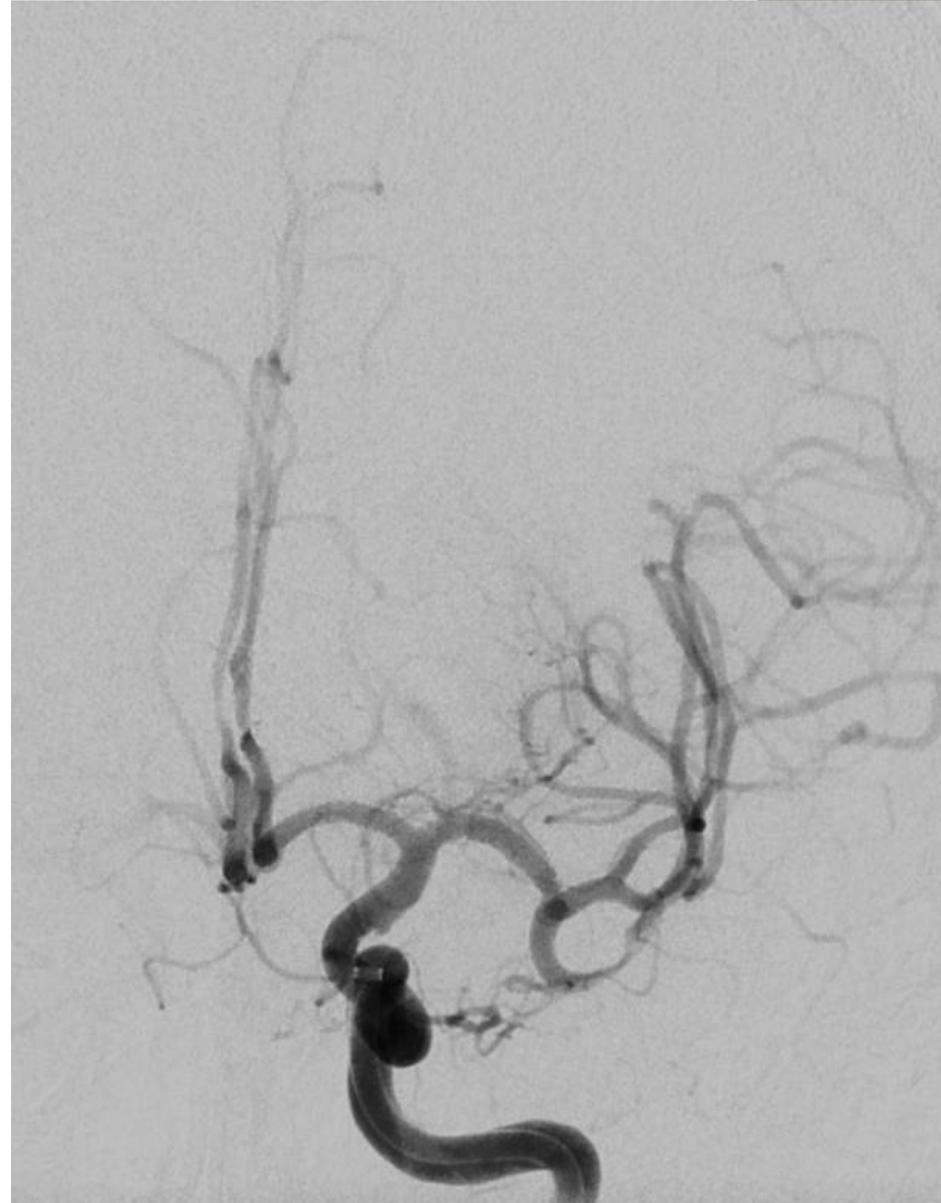
Intubate EARLY for increasing O₂ requirements

Airway management for deteriorating patients OR increasing oxygen requirements FiO₂ > 0.5 - Preoxygenate with facemask, with filter, BVM WITHOUT MANUAL VENTILATIONS. AVOID BIPAP, CPAP, Nasal High Flow Therapy

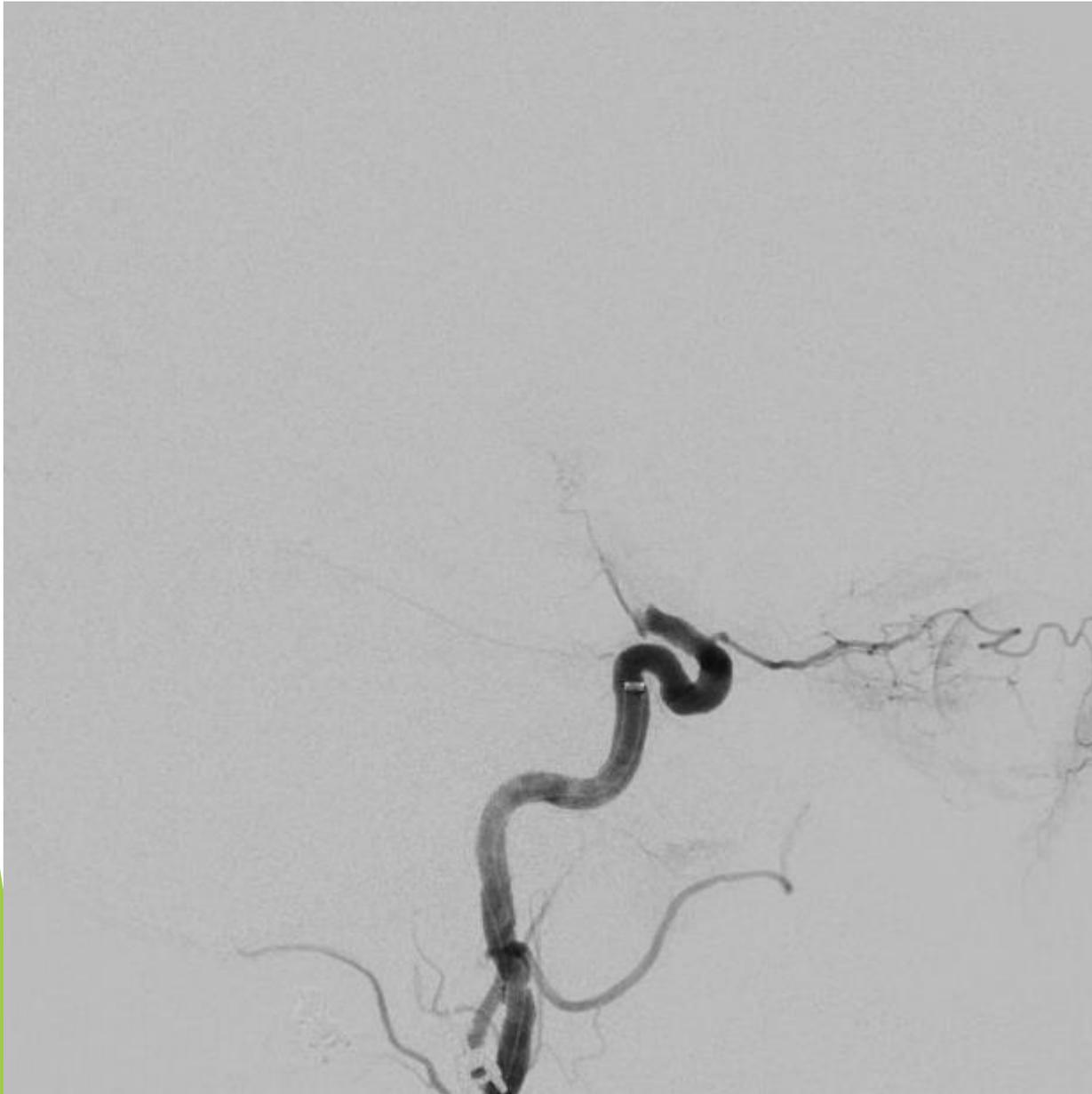


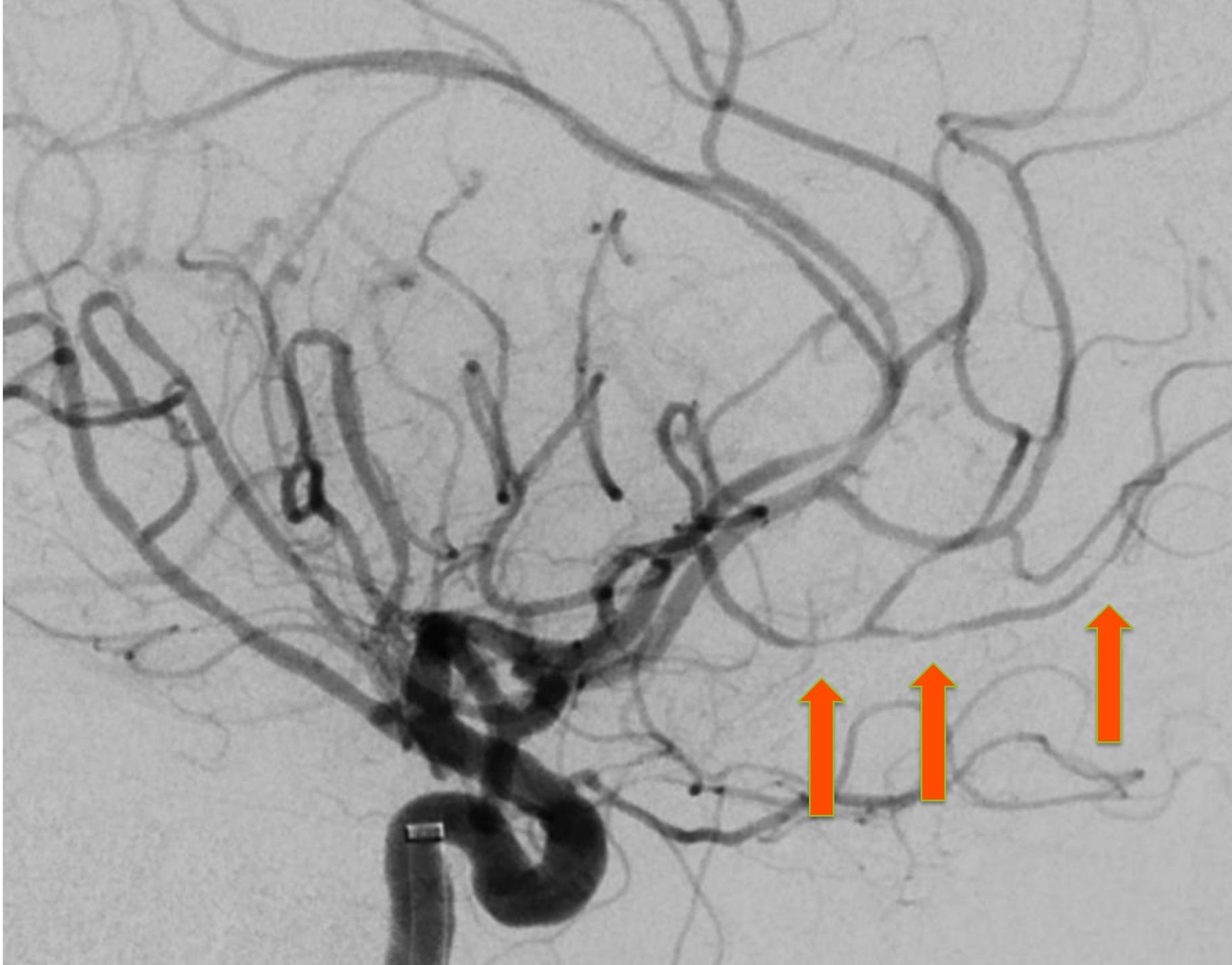
Crisis Resource Management: Role designation and clarity, closed loop communication, optimized team size, avoid cross-contamination

Mechanical Thrombectomy with Aspiration

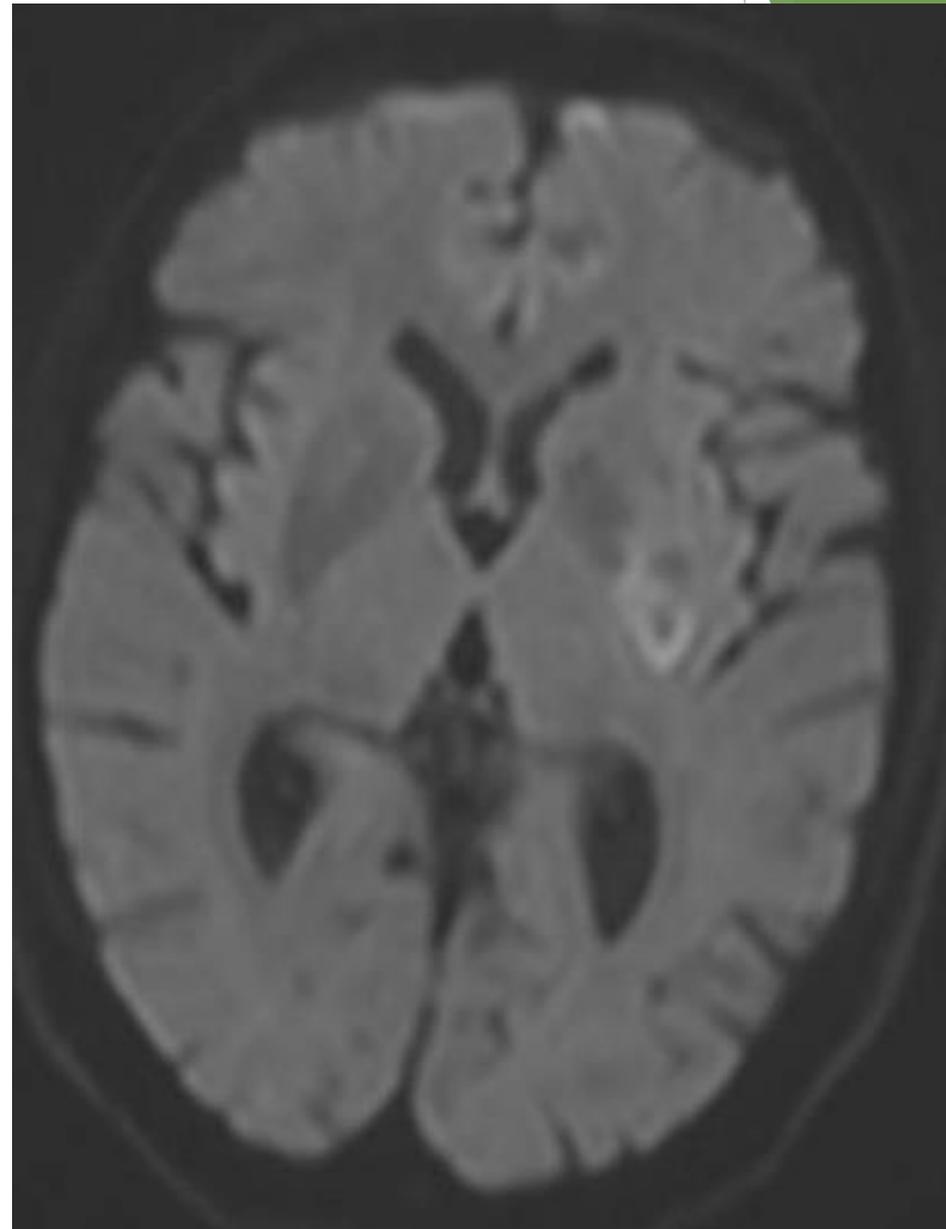
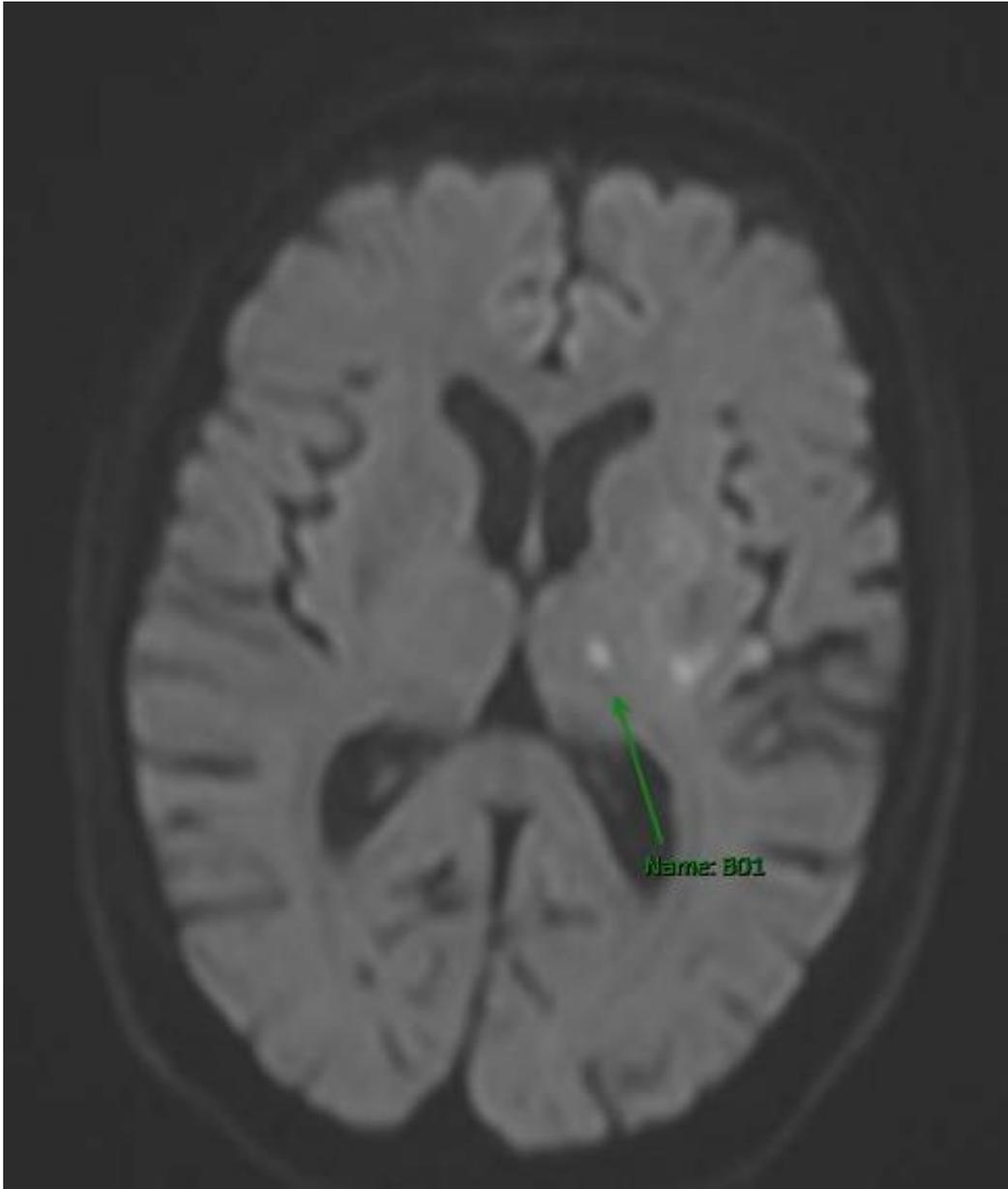


Mechanical Thrombectomy with Aspiration



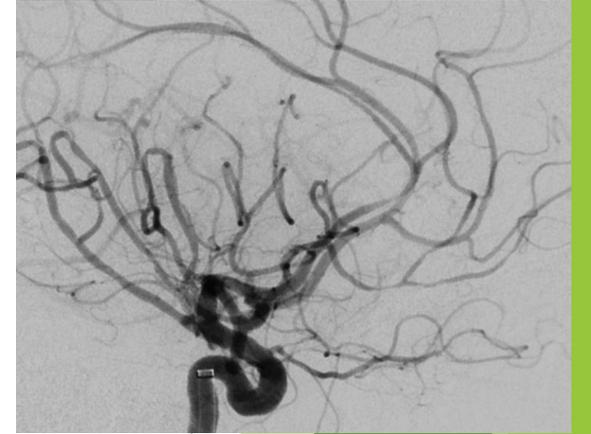


Punctate Areas of Restricted Diffusion



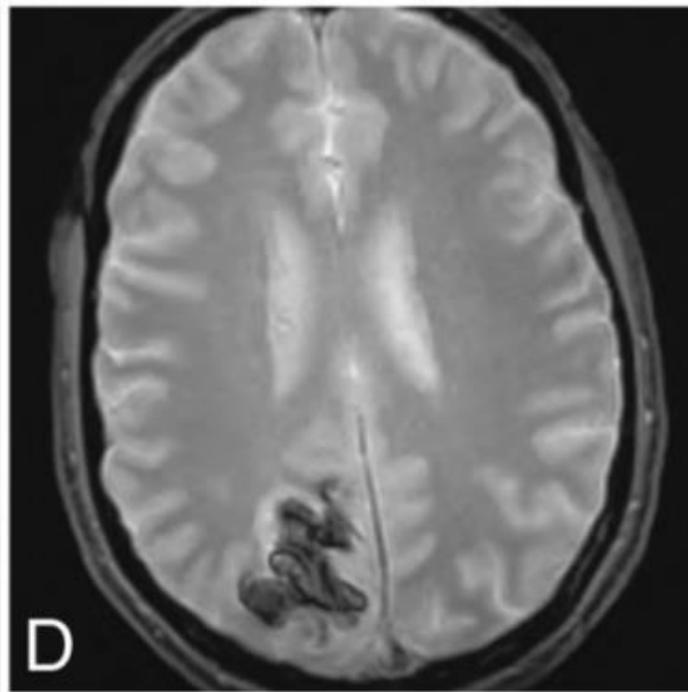
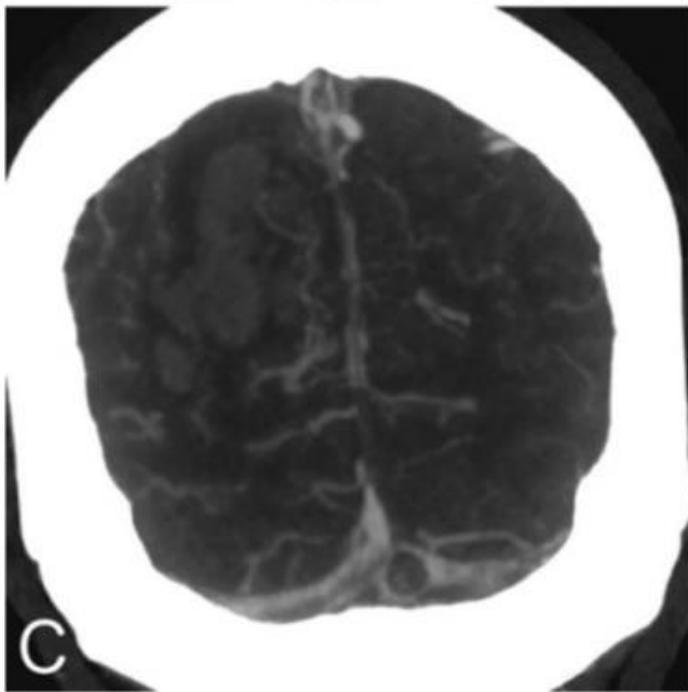
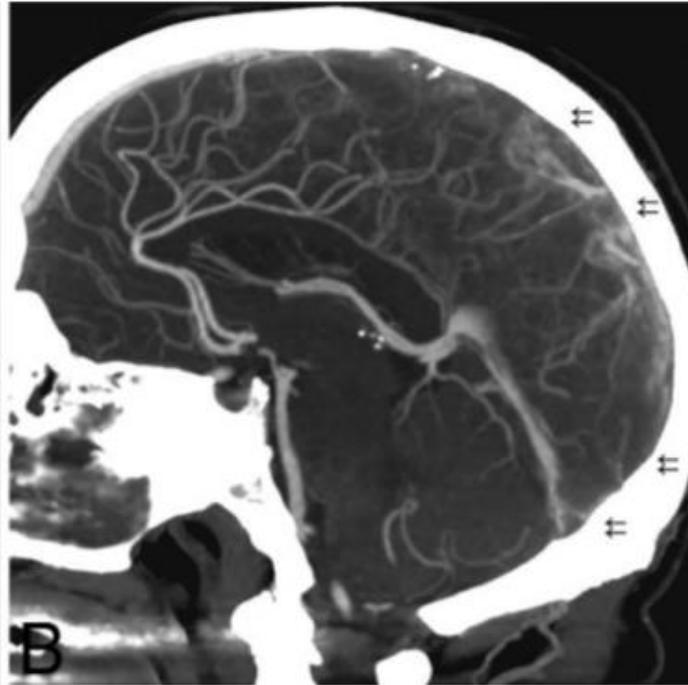
?COVID-19 Etiology for this Stroke?

- Large vessel occlusion?
 - Diagnosed with afib on hospital night 1
- Large vessel vasculopathy/vasculitis?
 - abnormal ANA and anti-double stranded DNA
 - CT angiogram unchanged at 3 m follow-up
 - Likely multifocal intracranial atherosclerosis
- Outcome?
 - Made a complete recovery, returned home
 - Now on apixaban

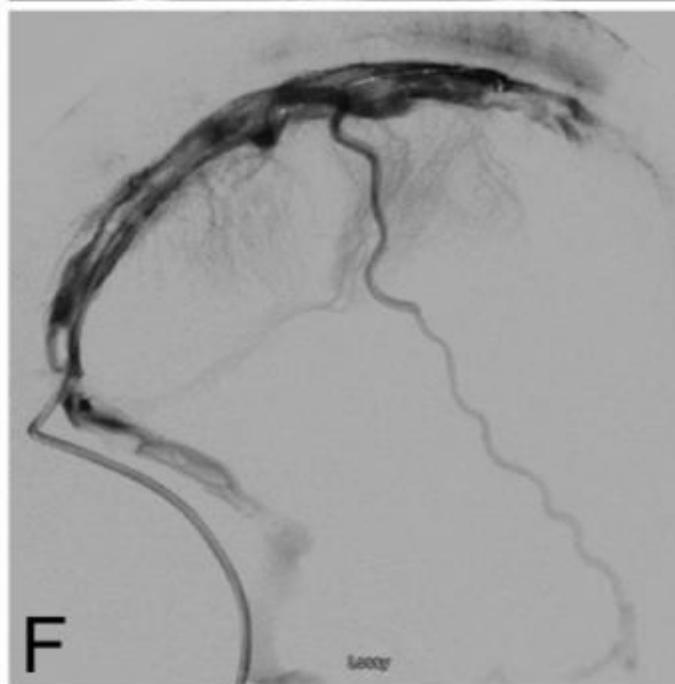
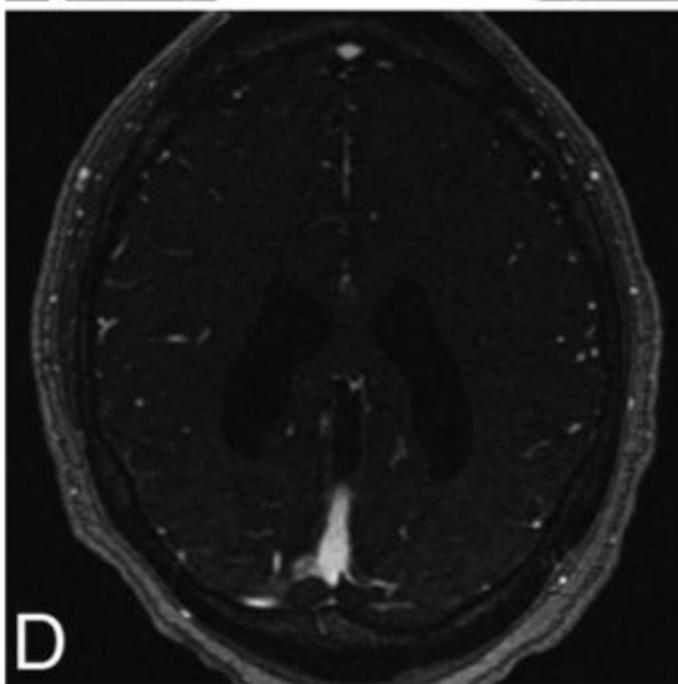
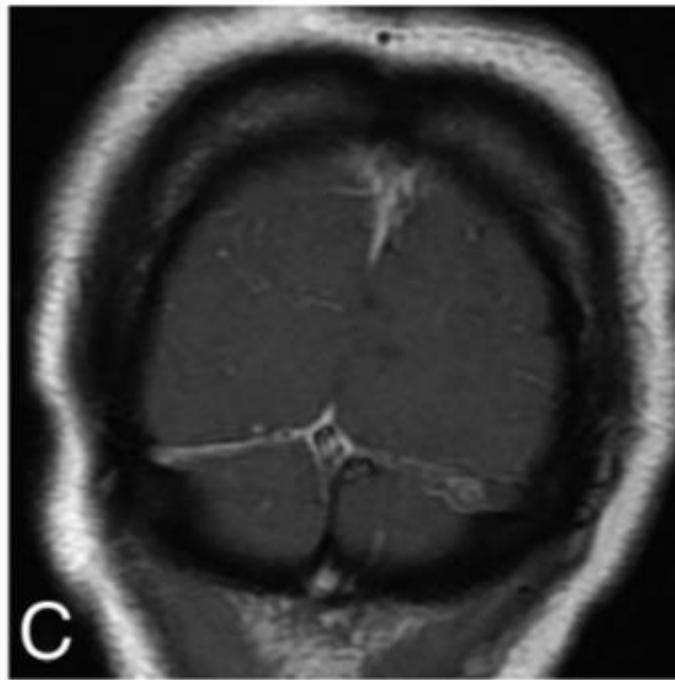
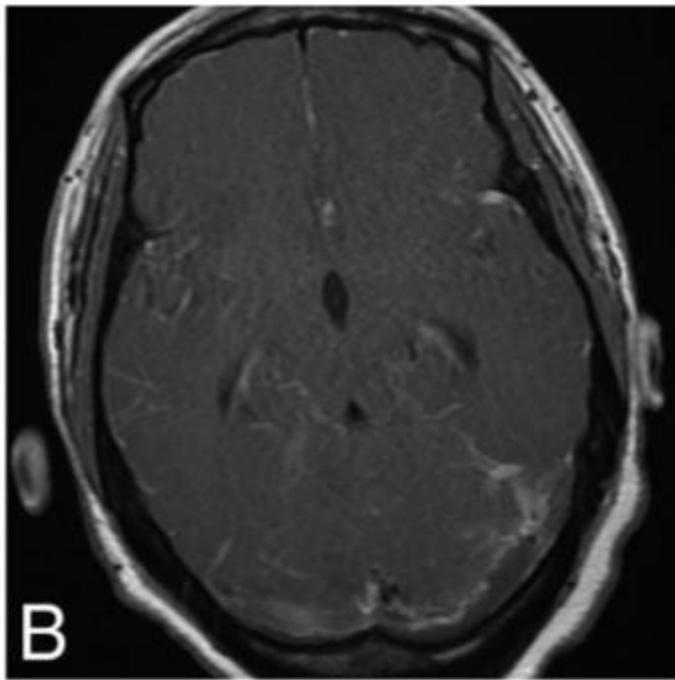
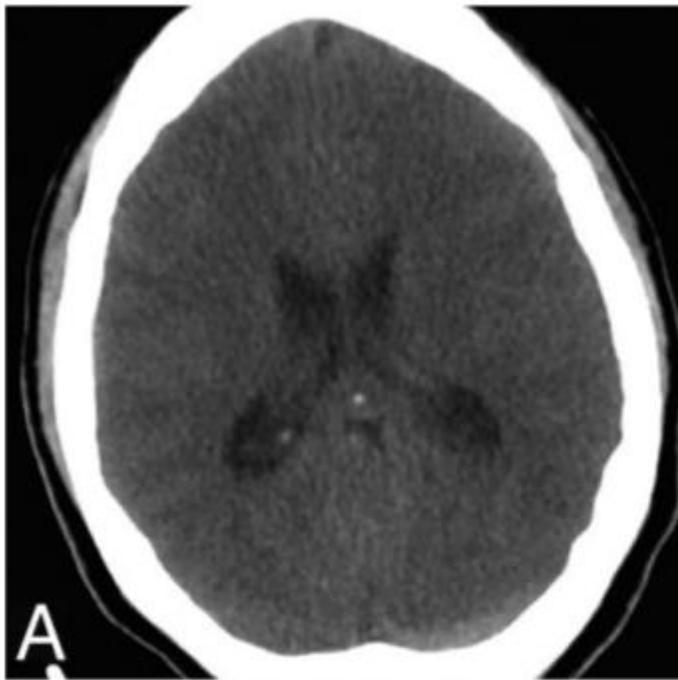


COVID-19 and Cerebral Venous Thrombosis

- ▶ Cerebral venous thrombosis in COVID-19: A New York Metropolitan Cohort Study, *AJNR* Apr 2021
 - ▶ Retrospective; multicenter; 13,500 pts; March 1 - May 31, 2020
 - ▶ 12 pts with CVT (incidence 8.8/10,000) vs 5/1,000,000 in general population
 - ▶ M:F, 2:1; average age: 49 (17-95); 1 pt with previous history of TE disease
 - ▶ Onset within 24 h of constitutional/respiratory sx in 58%
 - ▶ 75% of patients had venous infarct, hemorrhage or both on imaging
 - ▶ Mortality rate: 25% (non-COVID mortality: 8.3%, *Stroke* Jan 2012)
 - ▶ Management: anticoagulation, embolectomy, hematoma evacuation



CVT in COVID-19; Al-Mufti et al,
AJNR Apr 21



CVT in COVID-19; Al-Mufti et al, *AJNR* Apr 21

Cerebral venous thrombosis after vaccination against COVID-19 in the UK: multicentre cohort study

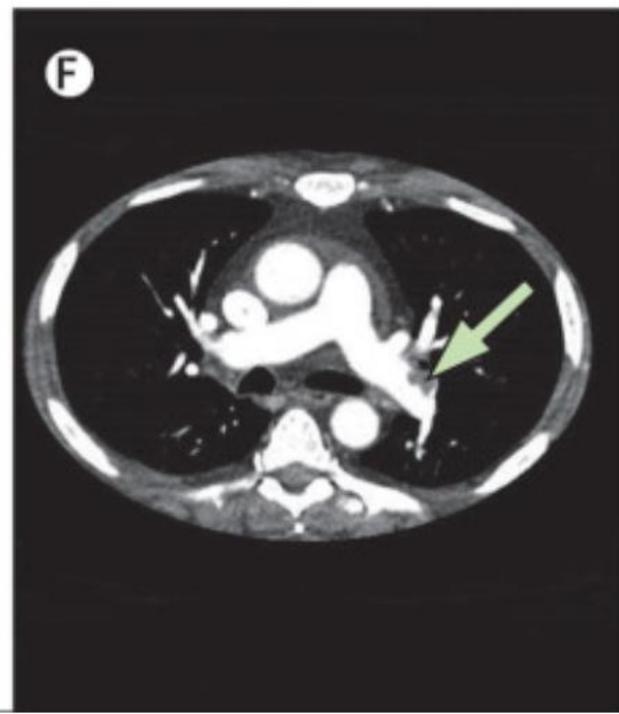
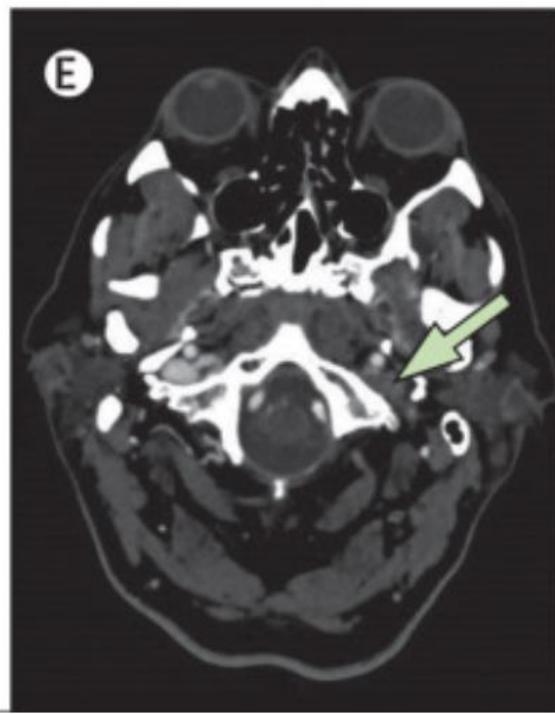
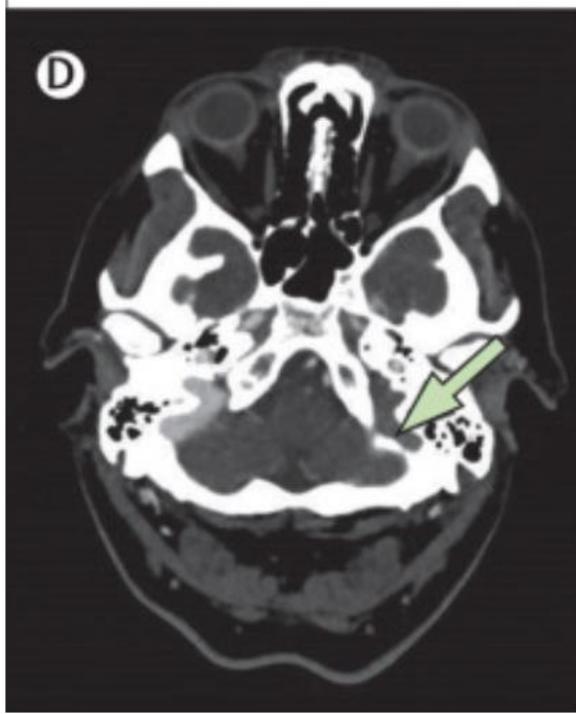
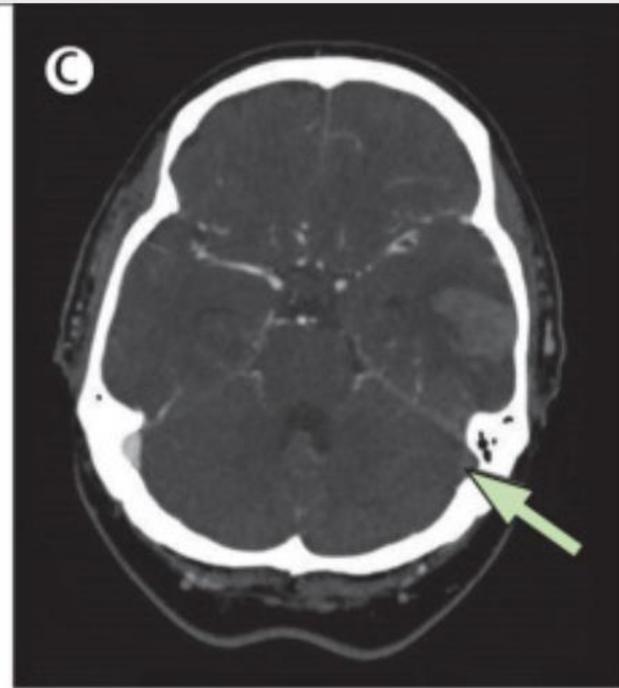
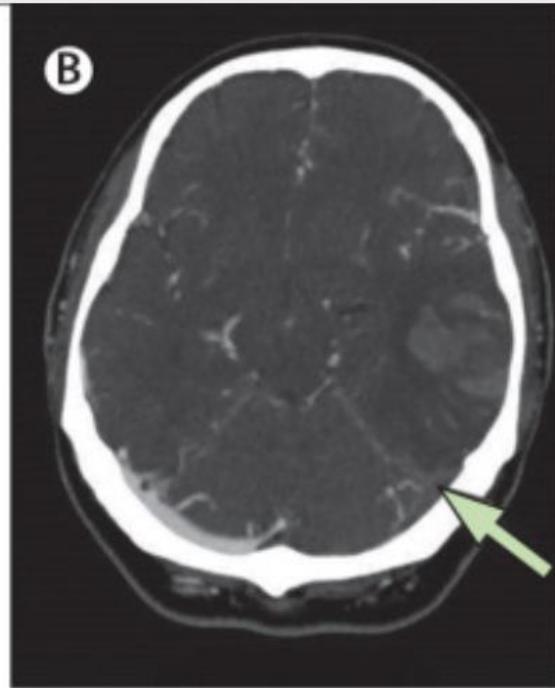
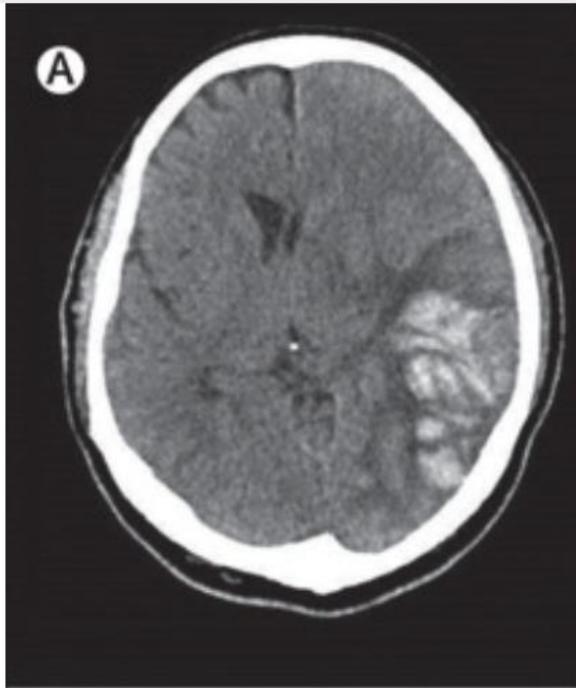
Lancet Aug 6, 2021

- ▶ Describes a new syndrome of vaccine-induced immune thrombocytopenia (VIIT) CVT as a rare side effect of vaccination against COVID-19
 - ▶ Submitted all cases of CVT occurring after vaccination
 - ▶ Collected clinical characteristics, lab values (including antiplatelet factor 4 antibodies), imaging
 - ▶ Defined CVT cases as VIIT if:
 - ▶ Lowest platelet count was below 150×10^9 per L
 - ▶ D-dimer greater than 2000 microgram/L
 - ▶ Compared CVT VIIT to CVT non-VIIT

Cerebral venous thrombosis after vaccination against COVID-19 in the UK: multicentre cohort study

Lancet Aug 6, 2021

- ▶ 95 pts from 43 hospitals between April 1 and May 20, 2021 with CVT post vaccination
 - ▶ 70 had VITT (vaccine-induced immune thrombotic thrombocytopenia)
 - ▶ median age: 47 vs 57 ($p=.0045$); mean time between vaccination and sx (9d v 11d)
 - ▶ Affected group had more intracranial veins thrombosed (3 vs 2, $p=.041$)
 - ▶ Affected group had more extracranial thrombosis (44% vs 4%, $p=.0003$)
 - ▶ Primary outcome of death or disability (47% vs 16%, $p=.0061$)
 - ▶ CVT more common in Astra-Zeneca and Johnson & Johnson adenovirus vector vaccines
 - ▶ mRNA vaccines associated with thrombocytopenia with purpura and mucosal bleeding



Thanks for Listening!
Mask up and stay safe!